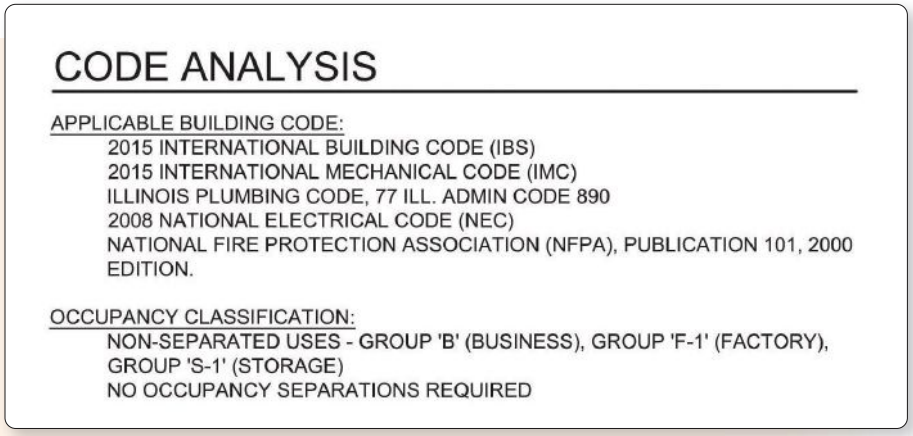
Erika L. Bolger, PE, LEED AP, *Design Group Facility Solutions, Oak Brook, Illinois*

Do you know the vital requirements for standby power?

The ability to provide power to a building or load when utility power is lost can be a critical need for a facility to support vital operations or building and occupant safety

Owners, architects, contractors and engineers tend to use the terms emergency/backup/standby power interchangeably to indicate that during a utility power outage, there is a need to have specific loads or even an entire structure's power maintained for facility operation.

There are distinct differences in the requirements for legally required standby power systems. The first step in designing a robust and code-compliant standby power system for a project is understanding the project requirements.


CODE ANALYSIS

APPLICABLE BUILDING CODE:
2015 INTERNATIONAL BUILDING CODE (IBS)
2015 INTERNATIONAL MECHANICAL CODE (IMC)
ILLINOIS PLUMBING CODE, 77 ILL. ADMIN CODE 890
2008 NATIONAL ELECTRICAL CODE (NEC)
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA), PUBLICATION 101, 2000 EDITION.

OCCUPANCY CLASSIFICATION:
NON-SEPARATED USES - GROUP 'B' (BUSINESS), GROUP 'F-1' (FACTORY), GROUP 'S-1' (STORAGE)
NO OCCUPANCY SEPARATIONS REQUIRED

FIGURE 1: Sample project code analysis summary that outlines pertinent information for understanding emergency and standby power requirements. These are typically found on the front pages of the architectural or general project drawings. Courtesy: Design Group Facility Solutions

Legally required standby power system loads are generally described as loads, which upon failure of the normal power source, could create hazards or hamper rescue or fire-fighting operations.

Depending on the project, there may be a need for various types of loads to be served by alternate power sources. These loads can include emergency loads that are loads legally required by governmental agencies for the purposes essential for safety for human life.

Legally required standby loads can also be present in a facility; these include loads that could create hazards or hamper rescue or fire-fighting operations if power is lost.

Additionally, optional standby systems may be present that include loads that, when stopped, could cause discomfort, serious interruption of the process or damage to the product or process.

Lastly, there may be additional loads that do not neatly fall into one of the above categories, but are still required based on an owner's request to be supported by an alternate power system mainly for reasons of convenience, comfort or financial impact. These load types could be considered optional standby loads.

There is some overlap between the various power systems above for the same load type. These loads should be classified based on the occupancy of the space as well as the function of the load. Additional clarification and guidance can be found in many of the codes and standards required for the proper design and construction of a building.

Standby power codes and standards

NFPA 70: National Electrical Code (NEC) Arti-

FIGURE 2: Double-wall diesel generator base-mounted fuel tank rated for required emergency power supply systems class. Courtesy: Design Group Facility Solutions

FIGURE 3: Exterior diesel generator with base-mounted fuel tank. Courtesy: Design Group Facility Solutions

cles 700, 701 and 702 provide directions as to the electrical safety of the installation, operation and maintenance of emergency, standby and optional standby systems. That is to say, the NEC dictates the technical requirements for electrical installations that include: commissioning, testing, capacity and rating, transfer equipment requirements, wiring methods, identification, etc.

These NEC articles provide guidance in general for the emergency power supply systems (EPSS) themselves along with other NEC code articles; other codes and standards such as the International Building Code (IBC), the NFPA 101: Life Safety Code, the International Mechanical Code and International Fire Code (IFC), local building codes and amendments, federal and military codes and standards, the Environmental Protection Agency, FM Global and other insurance company requirements, to name just a few, also have specific design criteria requirements.

These codes and standards provide further clarity on how loads within specific facilities should be treated. While the NEC is the code that electrical engineers reference most regularly, the designer or engineer cannot rely solely on the NEC for direction; in fact, there are many other sources in which criteria for the proper application of alternate power systems can be found.

NFPA 110: Standard for Emergency and Standby Power Systems defines the following:

> "EPSS: A complete functioning emergency power supply system coupled to a system of conductors, disconnecting means and overcurrent protection devices, transfer switches and all control, supervisory and support devices up to and including the load terminals of the transfer equipment needed for the system to operate as a safe and reliable source of power."

The terms EPSS and standby power supply systems include but are not limited to:

- Emergency power systems.
- Alternate power systems.
- Standby power systems.
- Legally required standby systems.
- Alternate power sources.

NFPA 110 specifies the installation, performance, maintenance and test requirements for EPSSs in terms of types, classes and levels for the

The NEC dictates the technical requirements for electrical installations that include: commissioning, testing, capacity and rating, transfer equipment requirements, wiring methods, identification, etc.

Learning **Objectives**

- **Determine** the proper classification of loads requiring an alternate power source.
- **Learn about** alternate power source terminology and code requirements of different alternate power sources and systems.
- **Understand** where to look to determine the requirements of standby power systems.

NFPA 110 provides excellent guidance in understanding the requirement when classifying the requirements of different types of emergency power supply systems.

categories above, therefore the category terms used depend on the application involved. These types, classes and levels are essential in helping to distinguish the proper classification of the alternate power distribution system.

An EPSS class refers to the length of time required for an EPSS to provide power to a load (duration the load can be served) without being refueled (NFPA 110 Table 4.1(a)) as well as the maximum time allowed for the load terminals of transfer equipment to be without acceptable power (how quickly the load needs to receive power, (NFPA 110 Table 4.1(b)).

Further, NFPA 110 defines levels for EPSS equipment installation, performance and maintenance requirements. A Level 1 system is where failure of the equipment to perform could result in loss of human life or serious injuries. A Level 2 system is where failure of the EPSS to perform is less critical to human life and safety. NFPA 110 Appendix A is a reference to assist the designer in understanding the intent of what loads might qualify as either Level 1 or Level 2.

NFPA 110 provides excellent guidance in understanding the requirement when classifying the requirements of different types of emergency power supply systems, but how does the designer know which components of a building or project are applicable to these classifications? Start with the understanding of the project and its occupancy and use classification in the applicable building code or standard.

Understanding power system intent

The building code or standard for a given municipality is dictated by the authority having jurisdiction (AHJ). The AHJ, whether that is the local building department or other governmental agency will determine the building code that is applicable at the time of design. The IBC is a common compliance requirement for many buildings.

The IBC defines the following terms:

CASE STUDY: **Food production facility requires varied power approach**

THIS FOOD PRODUCTION FACILITY was broken into three areas, each of which achieve specific power needs

A new flagship refrigerated food production facility is being constructed. The facility is 250,000 square feet, primarily single story (36-foot high production and warehouse space) with a three-story office area including an atrium.

The building requires a fire alarm system and given the refrigerated production areas, a large machine room is present that uses anhydrous ammonia refrigeration compressors to provide cooling to the process spaces. In addition, the owner has requested that the entire office area operate during a power outage.

During design, it is determined that the building occupancy areas include: business (B-1), factory (F-1) and storage (S-1). The applicable codes per the municipality include:

- 2021 International Building Code (IBC).
- 2021 International Fire Code (IFC).
- 2023 NFPA 70: National Electrical Code (NEC).

Building code requirements

IBC requirements:

Per Article 2702.2, the smoke control system required for the three-story office atrium is required to be provided with standby power (2702.2.17 and 404.7). Further, the standby power source and its transfer switches shall be in a separate room from the normal power transformers and switch gears and directly ventilated to and from the exterior (per 909.11.1).

Per Article 2702.2.14, emergency power is required for the building egress illumination and fire alarm systems.

IFC requirements:

Per Article 916.5 and ANSI/IIAR CO2-2021 Safety Standard for Closed-Circuit Carbon Dioxide Refrigeration Systems as well as good engineering practices, standby and emergency power shall be provided to serve the gas detection system and emergency ventilation system within the ammonia machine room.

"Emergency power system: A source of automatic electric power of a required capacity and duration to operate required life safety, fire alarm, detection and ventilation systems in the event of a power failure of the primary power. Emergency power systems are required for electrical loads where interruption of the primary power could result in the loss of human life or serious injury."

These systems are required to make power available within 10 seconds per NFPA 70 Section 700.12.

"Standby power system: A source of automatic electric power of a required capacity and duration to operate required building, hazardous material or ventilation systems in the event of a failure of the primary power. Standby power systems are required for electrical loads where interruption of the primary power could create hazards or hamper rescue or fire-fighting operations."

These systems are required to make power available within 60 seconds per NFPA 70 Section 701.12.

FIGURE 4: Dedicated transfer switches for separate emergency power supply systems loads. Courtesy: Design Group Facility Solutions

NEC Article 701.1, Informational Notes 4 and 5 further correlate the intent of standby system loads as being loads that any interruption of could create a hazard or hamper rescue or fire-fighting efforts and could result in loss of human life (Level 1) or less critical to human life and safety (Level 2).

Why standby power systems matter

Understanding the intent of the various codes and standards is interesting, but as designers, why should we care? We care because based on the types of loads, different requirements are required for different load types including but not limited to: operation, location and installation.

Insights
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Standby power insights

- **Understanding** the differences, intended use and limitations between legally required standby power systems and other alternate power systems is critical to meeting a project's goals and maintaining code requirements of loads being served.
- **This article** will focus on specifics with respect to legally required standby power systems.

Per Article 1203.1.4, emergency power systems shall automatically provide secondary power within 10 seconds after the primary power is lost. Standby power systems shall automatically provide power within 60 seconds after primary power is lost. Additionally, emergency and standby power systems shall be designed to provide the required power for a minimum duration of two hours without being refueled or recharged.

The IBC and IFC, as well as the owner's project requirements, have dictated all the required loads that require an alternate source of power during the loss of normal power, these have been formally categorized (see classifications).

National Electrical Code requirements:

Per Part III of NEC Article 700 Sources of Power, the selection of a power source should be based on the consideration of the occupancy and type of service to be rendered. This includes the type of power source, the run-time duration of load, reliability of the alternate power source fuel type and type of loads.

Food production facility load classifications

Emergency power	Legally required standby power	Backup power
Egress lighting	Smoke control systems	Office power and HVAC
Fire alarm systems	Gas detection and emergency exhaust for the compressor room	
Fire pump		

Example of alternate power source load classifications for a large-scale industrial project. Courtesy: Design Group Facility Solutions

In this example, a standby, exterior diesel generator was selected because of the types of loads (motor loads serving the smoke control systems and exhaust fans as well as the compressor loads serving the air conditioning). While this facility was designed with a single emergency power generator, separate and distinct branches of emergency power distribution were provided (code required emergency, legally required standby and optional standby) to meet the intent of Article 700.10(B).

For example, IBC Chapter 909.11 requires that for smoke control systems, the standby power source and its transfer switches shall be in a separate room from the normal power transformers and switchgears.

NEC Article 701:

- Indicates a legally required standby system shall have the load capacity calculated in accordance with Parts I through IV of Article 220 or other approved method.
- Dictates the design of the transfer equipment of the standby power system to include allowing the ability to bypass the transfer equipment and the requirement for the transfer equipment to be electrically operated and mechanically held.
- Mandates signage at the service entrance identifying each legally required standby power source.
- Defines the maximum time allowed for the legally required standby source to become available to support the required loads (60 seconds, or per NFPA 110, Type 60).
- Defines the minimum operation time before refueling (two hours, or per NFPA 110, Class 2).
- Provides an approved list of alternate power sources that can be used for standby power systems (some of which require AHJ approval). These include:

– Public gas system.
– Municipal water supply.
– Storage batteries.
– Generator sets.
– Stored energy power systems.
– Separate service.

FIGURE 5: Emergency maintenance "triple switch." Courtesy: Design Group Facility Solutions

– Connection ahead of the service disconnecting means.
– Microgrid systems.

- The standby power source should be carefully evaluated based on the loads supported and their purpose.

It is important to understand that the NEC, IBC, NFPA 110 or other codes and standards are to be used as a guide and minimal compliance standard only. It is impossible for these documents to be comprehensive for every situation, so it is up to the design professional with approval by the AHJ to determine the proper classification of the electrical loads on each project while meeting the owner's project goals.

It is the responsibility of the electrical designer to stay current with the understanding of the ever-changing code requirements. The major building and construction codes typically provide changes on a three-year code cycle. The requirements for standby power systems are no exception. cse

Erika L. Bolger, *PE, LEED AP, is a director at Design Group Facility Solutions and has more than 30 years of consulting engineering experience.*